

Rapid Review of the literature: Assessing the infection prevention and control measures for the prevention and management of COVID-19 in healthcare settings

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Abbreviations

ABHR	Alcohol based hand rub
AGP	Aerosol-generating procedure
FFP2	Filtering face piece respirator (class 2)
FFP3	Filtering face piece respirator (class 3)
FRSM	Fluid-resistant surgical face mask
HDU	High dependency unit
ICU	Intensive care unit
ITU	Intensive therapy unit
MERS-CoV	Middle East respiratory syndrome coronavirus
NIPCM	National Infection Prevention and Control Manual
NERVTAG	New and Emerging Respiratory Virus Threat Assessment Group
PPE	Personal protective equipment
RPE	Respiratory protective equipment
SARS-CoV	Severe acute respiratory syndrome coronavirus
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
WHO	World Health Organization

1. Aim

To provide a rapid review of the scientific evidence base to determine if the infection prevention and control measures applied in Scotland are suitable for the prevention and management of COVID-19 in healthcare settings.

2. Objectives

Objectives for the rapid review were to establish the following:

- The routes of transmission;
- The incubation period;
- The infectious period;
- The environmental survivability of the SARS-CoV-2;
- The methods for cleaning/decontamination of the care environment;
- The personal protection equipment (PPE) requirements;
- The respiratory protection equipment (RPE) requirements;
- The methods of hand hygiene.

3. Search Strategy

Academic databases were searched on 5th March 2020 to identify relevant literature and additional hand searching was conducted.

The search terms were as follows:

1. COVID-19.mp.
2. SARS-CoV-2.mp.
3. 2019-nCoV.mp.
4. novel coronavirus.mp.
5. exp coronavirus/
6. 1 or 2 or 3 or 4 or 5
7. exp infection control/

8. exp disinfection/
9. exp decontamination/
- 10.exp personal protective equipment/
- 11.surgical mask?.mp.
- 12.surgical mask?.mp.
- 13.hand hygiene.mp.
- 14.clean*.mp.
- 15.transmission.mp.
- 16.7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15
- 17.6 and 16
- 18.limit 17 to English language
- 19.limit 18 to yr="2020 -Current"

Evidence updates

The evidence base for this rapid review will be updated real-time as per the methodology of the National Infection Prevention and Control Manual (NIPCM).

Results

An overarching limitation of all identified evidence is the novel nature of SARS-CoV-2 and the limited ability for robust research at the early stages of an outbreak. Most papers highlighted the need for further research, with existing SARS-CoV and MERS-CoV knowledge filling current gaps where appropriate.

4. Transmission routes

The initial phylogenetic and immunologic similarities between SARS-CoV and SARS-CoV-2 can be extrapolated to gain insight into some of the transmission characteristics where there is a paucity of evidence.

The transmission of COVID-19 is thought to occur mainly through respiratory droplets generated by coughing and sneezing, and through contact with contaminated surfaces. Preliminary evidence indicates the routes of transmission to be droplet¹⁻¹⁰ and contact.^{1, 3, 6-11} Evidence also supports indirect contact.^{1, 6, 7, 9, 10} These transmission routes are supported by National¹²⁻¹⁴ and international guidance.^{15, 16}

Currently there is no clear evidence of airborne transmission of SARS-CoV-2. Aerosol-generating procedures (AGPs) have been associated with an increased risk of transmission of previous coronaviruses (SARS-CoV and MERS-CoV)¹⁶ and a number of AGPs have been identified as risk factors for SARS-CoV-2.⁹ Therefore airborne precautions should be put in place for all AGPs performed on suspected/confirmed COVID-19 patients.

There is limited evidence regarding mother-to-child transmission. A small study investigating delivery via caesarean section found no evidence of vertical transmission in pregnant women who developed COVID-19 pneumonia in the third trimester however further research is needed.¹⁷

A number of papers cited the need for more research into the possibility of faecal-oral transmission^{2, 6, 7, 9-11, 18, 19} following the discovery of viral RNA in the stool samples of COVID-19 patients.^{20, 21} however initial attempts at virus isolation from stool have been unsuccessful.²² The application of standard infection control precautions (SICPs) would prevent ongoing transmission via this route.

SARS-CoV-2 has also been detected in the tears and conjunctival secretions in COVID-19 patients with conjunctivitis⁴ leading to the suggestion that transmission could be possible via the mucous membranes of the eyes.^{23, 24} All secretions (except sweat) and excretions from patients with known or suspected COVID-19, should therefore be regarded as potentially infectious.

Conclusion:

- Standard Infection Control Precautions (SICPs) should be applied at all times regardless of the infectious nature of the patient.
- Droplet precautions should be implemented when in close contact (up to 2 metres) with, or providing direct patient care of, a suspected/confirmed COVID-19 patient.
- Airborne precautions should be implemented when undertaking an AGP. See [Appendix 16 of the NIPCM](#) for more information.

5. Incubation period

Early reports vary regarding the incubation period and many of the studies published to date are limited by the small sample sizes and over-representation of severe cases, the incubation period for which may differ from that of mild cases. Evidence to date suggests an incubation period of 5-6 days^{7, 10, 25-32} with a range of 1-14 days^{7, 8, 11, 28, 30, 32, 33} from infection to symptoms surfacing.

Conclusion:

- The incubation period for most people is 5-6 days (range 1-14 days).
- Self-isolation for 7 days is recommended for individuals with symptoms consistent with COVID-19.
- Self-isolation for 14 days is recommended for contacts of symptomatic cases.

6. Infectious period

Assessment of the clinical and epidemiological characteristics of SARS-CoV-2 cases suggests that, similar to SARS-CoV, patients will not be infectious until the onset of symptoms.²⁸ In most cases, individuals are usually considered infectious whilst they have symptoms; how infectious an individual is depends on the severity of their symptoms and stage of their illness. Initial data from Wuhan suggested a median time from symptom onset to clinical recovery for mild cases of approximately 2 weeks and 3-6 weeks for severe or critical cases however this data is likely biased by the fact that the majority of cases were hospitalized, requiring intensive care and it is unknown from the study but likely that the cases had underlying conditions or pre-disposing risk factors.²⁸ Lauer et al estimate that most (97%) of those who develop symptoms do so within 11.5 days of

infection (95% CI, 8.2-15.6), which under conservative assumptions, can be extrapolated to determine that only a limited number of cases will develop symptoms out-with the 14 days of active monitoring or quarantine.²⁷

There have been reports that suggest possible infectivity during the asymptomatic period.^{10, 33-38} This is based on limited evidence, from observations during contact tracing³⁶ and identification of viral RNA in clinical samples in asymptomatic patients.³⁵ Such studies are limited by their small sample size (n=5-7 cases)^{35, 36} and observational nature. It is also as yet unknown if detection of viral RNA in clinical samples in the asymptomatic period is indicative of presence of transmissible infectious viral cells; the viral RNA could be from inactive cells. Initial evidence from a single study with a small sample size found that virus can be isolated from clinical samples taken within the first 7 days of symptoms but not from day 8 onwards.²² As clinical sampling may not be widely conducted on mild/asymptomatic community-based cases, there may continue to be a paucity of data in relation to determination of asymptomatic transmission. From limited international data, the balance of evidence is that, for mild cases of infection, infectivity significantly reduces 7 days after the onset of symptoms²² but appears to take longer for severe cases.³⁹ Wolfel et al estimate that, for patients beyond day 10 of symptoms and with less than 100,000 viral RNA copies per ml of sputum, early discharge with ensuing home isolation might be appropriate.²²

Conclusion:

- Transmission is most likely to occur whilst a person is symptomatic.
- In mild cases of infection, the risk of transmission reduces after 7 days.
- In severe cases the risk of transmission may extend beyond 7 days therefore Transmission Based Precautions (TBPs) should remain in place for the duration of hospital admission or until cessation of symptoms.

7. Survival in the environment

In light of limited data for SARS-CoV-2, evidence was assessed from studies conducted with previous human coronaviruses including MERS-CoV and SARS-CoV. From largely experimental studies, human coronaviruses are capable of surviving on inanimate objects and can remain viable for up to 5 days at temperatures of 22-25°C and relative humidity of 40-50% (which is typical of air conditioned indoor environments).^{11, 19, 40-43} Survival is also

dependent on the surface type.⁴⁰ An experimental study using a SARS-CoV-2 strain reported viability on plastic for up to 72 hours, for 48 hours on stainless steel and up to 8 hours on copper.⁴⁴ Viability was quantified by end-point titration on Vero E6 cells.

Conclusion:

- Due to the uncertainty regarding the environmental survivability of SARS-CoV2 in real-life conditions, it is essential to increase the frequency of routine cleaning and ensure that the environment is clutter free.

8. Environmental decontamination

Evidence for cleaning of the care environment for COVID-19 is limited; studies that evaluate the susceptibility of coronaviruses to cleaning/disinfectant products differ by their methodology and often use animal coronaviruses in experimental conditions.^{19, 40, 45} An experimental study using a SARS-CoV isolate, tested three different surface disinfectants but all required over 30 minutes exposure time to inactivate the virus to levels below detection.⁴⁵ Limited evidence suggests that coronaviruses are susceptible to chlorine-based disinfectants and ethanol-based antiseptics.^{40, 46} Kampf et al summarised the efficacy of various disinfectants against both human and animal coronaviruses and found that a concentration of 0.1% sodium hypochlorite was effective in 1 minute and, for the disinfection of small surfaces, 62-71% ethanol revealed a similar efficacy.⁴⁰ The World Health Organization (WHO) recommends that, for coronaviruses, commonly used hospital-level disinfectants such as sodium hypochlorite (at a concentration of 0.1%) are effective for cleaning environmental surfaces, and 70% ethanol is suitable for disinfecting small surfaces.¹⁶

Conclusion:

- Environmental cleaning and disinfection should be carried out in line with the National Infection Prevention and Control Manual (NIPCM).
- This includes: a combined detergent/disinfectant solution at a dilution of 1,000 parts per million available chlorine (ppm available chlorine (av.cl.)) for transmission-based environmental cleaning.⁴⁷ Small surfaces can be disinfected with 70% ethanol.

9. Personal protective equipment

There was limited evidence for the assessment of the PPE and RPE requirements for the prevention of transmission of SARS-CoV-2.

Identified guidelines recommend the use of disposable gloves, disposable plastic aprons, fluid-resistant surgical facemasks (FRSM), and eye protection for healthcare workers to protect against transmission.^{8, 9, 12, 16, 48-50} This is in line with National PPE recommendations for droplet precautions as per the NIPCM.⁵¹ A systematic review and meta-analysis of observational studies conducted pre-COVID-19 found a protective effect of up to 80% for masks and respirators used by healthcare workers against SARS-CoV however the existing evidence base was sparse and indications (and compliance) for mask/respirator use varied between studies.⁴⁸ It should be noted that N95 respirators are not recommended for use in UK healthcare settings. In the UK, FFP3 respirators should be worn for airborne precautions and when performing AGPs, and must be compliant with EN149:2001 FFP3. During AGPs there is an increased risk of aerosol spread of infectious agents irrespective of the mode of transmission (contact, droplet, or airborne) and airborne precautions (FFP3 respirator and facial protection) must be implemented.⁴⁷ The importance of this is highlighted by the recognised risk of aerosol transmission when performing AGPs on COVID-19 patients (see section on [Transmission Routes](#)). PHE also recommend that, in addition to FFP3 respirators and face protection, disposable gloves and long sleeved disposable gowns should be worn when performing AGPs.¹² Face protection is particularly important given the uncertainty regarding the risk of ocular transmission.^{23, 24} For general patient care (i.e. non-AGP situations), UK IPC guidance recommends FRSMs, disposable aprons and disposable gloves, with the decision to wear eye protection based on risk assessment.¹⁴

Conclusion:

- Droplet precautions should be adhered to for general patient care.
- Airborne precautions are required when performing AGPs on patients with COVID-19.

10. Respiratory protection equipment

In light of the above, the Department of Health and Social Care's New and Emerging Respiratory Virus Threat Assessment Group (NERVTAG) have recommended that

airborne precautions should be implemented at all times in clinical areas considered AGP 'hot spots' e.g. Intensive Care Units (ICU), Intensive Therapy Units (ITU) or High Dependency Units (HDU) that are managing COVID-19 patients (unless patients are isolated in a negative pressure isolation room/or single room, where only staff entering the room need wear a FFP3 respirator).

In areas where AGPs are less frequently performed a fluid-resistant (Type IIR) surgical mask (FRSM) is recommended; all general ward staff, community, ambulance and social care staff should wear an FRSM for close patient contact (within 2 metres), unless performing an AGP, when a filtering face piece (class 3) (FFP3) respirator should be worn.

Conclusion:

- FFP3 respirators should be worn at all times in clinical areas considered AGP 'hot spots' such as ICUs, ITUs and HDUs, and in all clinical settings when performing an AGP.
- Fluid-resistant (Type IIR) surgical facemasks should be worn in all other clinical settings (i.e. general wards), and, when entering cohort areas when no patient contact is anticipated.

11. Hand hygiene

The majority of articles identified recommend that hand hygiene should be performed, however many do not specify the method(s) to be used in preventing the transmission of SARS-CoV-2. A number of guidance documents provide specific methodologies which differ only slightly.^{8, 12, 16} WHO and Public Health England support the use of soap and water, and alcohol-based hand rub (ABHR) when soap and water is not available and when hands are not visibly soiled.^{12, 16} Rabenau et al provide experimental evidence for the efficacy of commercially-available ABHRs against SARS-CoV and reported deactivation to below the detectable limit within a contact time of 30 seconds.⁴⁵ Due to the similarity between SARS-CoV and SARS-CoV-2, it is likely that ABHRs would be effective against both viruses.

Conclusion:

- Hand hygiene should be performed with soap and water or, when hands are not visibly soiled, with ABHR in line with the NIPCM.

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